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DESCRIPTION

Resin Composition for Reflector Plate and Reflector plate

5   TECHNICAL FIELD

The present invention relates to a resin composition
suitable for a reflector plate and a reflector plate formed
from the resin composition. More particularly, the
10   invention relates to a polyamide resin composition suitable
for a reflector plate, which comprises a polyamide resin, an
inorganic filler and a white pigment, which is excellent in
reflectance, heat resistance, mechanical properties and
adhesive properties to a sealing resin and which at the same
15   time is suitable for insert molding, and which further
realizes a reduced drop of light reflectance over the course
of time when used as the reflector plate indoors and
outdoors, and to a reflector plate formed from the resin
composition.

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BACKGROUND ART

Reflector plates for effectively using light have been
used in various aspects. However, in recent years, due to

the light source gaining semiconductance (semiconductor laser and light emitting diode (hereinafter referred to as LED)), the miniaturization of a light source and the miniaturization of a device are achieved, and thus it is

5   required that the reflector plates to have not only high mechanical strength, but also good heat resistance and capability to be precisely molded. Particularly, in obtaining a reflector plate having high reflectance, a special insert molding has also been performed, and thus it

10   has required a resin composition which can be used in this application.

In this field, conventional LCPs (liquid crystal polymers) and heat resistant polyamide resins have been used. The LCPs are superior in heat resistance and light

15   resistance, and flowability during molding, but are inferior in adhesive properties to a sealing resin such as an epoxy resin used at sealing therewith after mounting a light emitting diode on a reflector plate.

Patent Documents 1 and 2 propose a resin composition

20   for a reflector plate, which is made by blending an inorganic filler to a polyamide resin composed of 1,9-diaminononane. However, this resin composition has a problem in adhesive properties to a sealing resin. Further, Patent Document 4 describes a polyamide resin composition

comprising an inorganic filler having an average particle

size of 2 μm or less, and Patent Document 5 describes a

polyamide resin containing potassium titanate fiber and/or

wollastonite. However, these polyamide resins are not

5 capable of obtaining sufficient rigidity during molding and

have problems as being used in insert molding. Furthermore,

Patent Documents 3, 6 and 7 describe a polyamide resin

containing a specific light stabilizer and having a less

discoloration of a molded product. However, these resins

10 have problems in productivities due to occurrence of a mold

deposit during molding.

[Patent Document 1]   WO 03/085029

[Patent Document 2]   JP-A No. 7-228776

[Patent Document 3]   JP-A No. 2004-75994

15 [Patent Document 4]   JP-A No. 2000-204244

[Patent Document 5]   JP-A No. 2002-294070

[Patent Document 6]   JP-A No. 2001-115014

[Patent Document 7]   JP-A No. 2001-115015

20 DISCLOSURE OF THE INVENTION

[Problems to be solved by the Invention]

It is an object of the present invention to provide a

polyamide resin composition that is excellent in mechanical

strength and heat resistance of a molded product and has no

problem as being used in precision insert molded products.

It is another object of the invention to provide a reflector

plate formed from the resin composition, which realizes a

5   reduced drop of light reflectance over the course of time

when used as the reflector plate.

[Means for solving the Problems]

In the light of these consideration, the present

inventors have studied intensively, and as a result, they

10   have found that a molded product formed of a specific

polyamide resin composition comprising a polyamide resin (A),

an inorganic filler (B) and a white pigment (C) is excellent

in mechanical strength and heat resistance and no problems

occur when the polyamide resin composition is use in

15   precision insert molded product, and a polyamide resin

composition further comprising a specific ultraviolet

absorber (D), or both an ultraviolet absorber (D) and a

hindered amine compound (E) and a reflector plate formed

from the resin composition realizes a reduced drop of light

20   reflectance over the course of time when used as the

reflector plate indoors and outdoors, and thus have

completed the present invention.

That is, the present invention provides:

(1) A polyamide resin composition which comprises 30 to

80% by mass of a polyamide resin (A) comprising (i) a

dicarboxylic acid component unit (a-1) consisting of 30 to

100 mol% of a dicarboxylic acid component unit derived from

terephthalic acid, 0 to 70 mol% of an aromatic dicarboxylic

5   acid component unit other than the terephthalic acid, and/or

0 to 70 mol% of an aliphatic dicarboxylic acid component

unit having 4 to 20 carbon atoms (provided that the total

amount of these dicarboxylic acid component units is 100

mol%) and (ii) 100 mol% of a diamine component unit (a-2)

10   consisting of a straight chain aliphatic diamine component

unit having 4 to 20 carbon atoms and/or a branched chain

aliphatic diamine component unit having 4 to 20 carbon atoms,

as a diamine component unit, 10 to 60% by mass of an

inorganic filler (B) and 5 to 50% by mass of a white pigment

15   (C), in which a molded product that is injection molded from

the polyamide resin composition has a flexural modulus of

elasticity at 130°C of 4500 MPa to 12000 MPa;

(2) A polyamide resin composition which comprises 30 to

80% by mass of a polyamide resin (A) comprising (i) a

20   dicarboxylic acid component unit (a-1) consisting of 30 to

100 mol% of a dicarboxylic acid component unit derived from

terephthalic acid, 0 to 70 mol% of an aromatic dicarboxylic

acid component unit other than the terephthalic acid, and/or

0 to 70 mol% of an aliphatic dicarboxylic acid component

unit having 4 to 20 carbon atoms (provided that the total

amount of these dicarboxylic acid component units is 100

mol%) and (ii) 100 mol% of a diamine component unit (a-2)

consisting of a straight chain aliphatic diamine component

5   unit having 4 to 20 carbon atoms and/or a branched chain

aliphatic diamine component unit having 4 to 20 carbon atoms,

as a diamine component unit, 10 to 60% by mass of an

inorganic filler (B) and 5 to 50% by mass of a white pigment

(C), in which the polyamide resin composition further

10   comprises an ultraviolet absorber (D) having a heating mass

reduction ratio of 50% by mass or less when held at 340°C

for 10 minutes under a nitrogen atmosphere, or both an

ultraviolet absorber (D) and a hindered amine compound (E);

and

15   (3) A reflector plate and a reflector plate for a light

emitting diode device, which are formed from the polyamide

resin composition.

[Effects of the Invention]

The invention can provide a polyamide resin composition

20   which has high light reflectance, high light stability and

good adhesive properties to a sealing resin, and which can

obtain a reflective plate molded product comprising an

insert molded-hoop material and a resin, which does not

occur problems in a post-process such as a set process of

LED by a sealing resin such as an epoxy resin and a solder reflow process, and a reflector plate formed from the resin composition.

5   BEST MODE FOR CARRYING OUT THE INVENTION

Hereinafter, the present invention will be explained in detail.

[Polyamide resin (A)]

10   The polyamide resin (A) used in the invention comprises a dicarboxylic acid component unit (a-1) and a diamine component unit (a-2).

[Dicarboxylic acid component unit (a-1)]

The dicarboxylic acid component unit (a-1) constituting

15   the polyamide resin (A) used in the invention preferably comprises 30 to 100 mol% of a terephthalic acid component unit, 0 to 70 mol% of an aromatic dicarboxylic acid component unit other than the terephthalic acid, and/or 0 to 70 mol% of an aliphatic dicarboxylic acid component unit

20   having 4 to 20 carbon atoms. Among these, as the aromatic dicarboxylic acid component unit other than the terephthalic acid, for example, isophthalic acid, 2-methylterephthalic acid, naphthalene dicarboxylic acid and a combination thereof are preferred.

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Further, the aliphatic dicarboxylic acid component unit, even though the number of carbon atoms thereof is not particularly limited, is derived from an aliphatic dicarboxylic acid having 4 to 20 carbon atoms and preferably 6 to 12 carbon atoms. Examples of the aliphatic dicarboxylic acid used for deriving the aliphatic dicarboxylic acid component unit include adipic acid, suberic acid, azelaic acid, sebacic acid, decanedicarboxylic acid, undecanedicarboxylic acid, dodecanedicarboxylic acid and the like. Among these, the adipic acid is particularly preferred.

Further in the invention, when the amount of the dicarboxylic acid component unit in the polyamide resin is 100 mol%, the polyamide resin preferably contains the terephthalic acid component unit in an amount of 30 to 100 mol%, preferably 40 to 100 mol%, and more preferably 40 to 80 mol%; the aromatic dicarboxylic acid component unit other than the terephthalic acid in an amount of 0 to 70 mol%, preferably 0 to 60 mol%, and more preferably 20 to 60 mol%; and/or the aliphatic dicarboxylic acid having 4 to 20 carbon atoms, preferably 6 to 12 carbon atoms in an amount of 0 to 70 mol%, preferably 0 to 60 mol% and more preferably 20 to 60 mol%.

Furthermore in the invention, the polyamide resin may

contain, as a dicarboxylic acid component unit (a-1), a

polyvalent carboxylic acid component unit in a small amount,

for example, in an amount of about 10 mol% or less, together

5   with the above-mentioned component units. Specific examples

of the polyvalent carboxylic acid component unit include

tribasic or polybasic acid such as trimellitic acid or

pyromellitic acid.

[Diamine component unit (a-2)]

10   The diamine component unit (a-2) constituting the

polyamide resin (A) used in the invention is preferably a

straight chain and/or branched chain aliphatic diamine

having 4 to 20 carbon atoms, preferably 6 to 12 carbon atoms.

Specific examples of the straight chain aliphatic

15   diamine component unit include 1,4-diaminobutane, 1,6-

diaminohexane, 1,7-diaminoheptane, 1,8-diaminooctane, 1,9-

diaminononane, 1,10-diaminodecane, 1,11-diaminoundecane and

1,12-diaminododecane. Of these, it is preferable to contain

1,6-diaminohexane in an amount of 50 to 100 mol%.

20   Specific examples of the branched straight chain

aliphatic diamine component unit include 2-methyl-1,5-

diaminopetane, 2-methyl-1,6-diaminohexane, 2-methyl-1,7-

diaminoheptane, 2-methyl-1,8-diaminooctane, 2-methyl-1,9-

diaminononane, 2-methyl-1,10-diaminodecane, 2-methyl-1,11-

diaminoundecane and the like. Of these, 2-methyl-1,7-
diaminoheptane, 2-methyl-1,8-diaminooctane and 2-methyl-1,9-
diaminononane are preferred.

5   The polyamide resin (A) used in the invention can be
prepared by a known method and prepared by the
polycondensation of a dicarboxylic acid component with a
diamine component. For example, as described in WO
03/085029, the polyamide resin can be prepared by heating
the dicarboxylic acid component and the diamine component in
10   the presence of a catalyst to obtain a lower condensate and
subsequently by carrying out the polycondensation by the
application of shear stress to a melt of the lower
condensate.

       The polyamide resin (A) used in the invention has an
15   intrinsic viscosity [η], as measured in 96.5% sulfuric acid
at 25°C, of 0.5 to 0.9 [dl/g], preferably 0.6 to 0.9 [dl/g],
and more preferably 0.7 to 0.9 [dl/g]. When it is in the
above ranges, the polyamide resin has excellent flowability
during molding. Further, the polyamide resin has a melting
20   point, as measured by DSC, usually in the range of 260 to
350°C, and particularly preferably in the range of 290 to
335°C. The polyamide resin having the above melting point
ranges is particularly excellent in heat resistance.

       [Inorganic filler (B)]

As the inorganic filler (B) used in the invention,
there can be various inorganic reinforcing materials in the
form of fiber, powder, granule, plate, needle, cloth, mat,
and the like used. More specifically, the inorganic filler

5   include inorganic fibers such as glass fiber, metal-coated
glass fiber, ceramic fiber, carbon fiber, metal carbide
fiber, hardened metal fiber, asbestos fiber and boron fiber.
Of these fibrous fillers, the glass fiber is particularly
preferable. By using the glass fiber, the moldability of

10   the composition improves and further improves mechanical
properties such as tensile strength, bending strength and
flexural modulus of elasticity, and heat resisting property
such as thermal deformation temperature of the molded
product formed from the resin composition. The glass fiber

15   has an average length of usually in the range of 0.1 to 20
mm, preferably in the range of 0.3 to 6 mm and an aspect
ratio (L (average length of fiber) / D (average outer
diameter of fiber) of usually in the range of 10 to 2000,
preferably in the range of 30 to 600. It is preferable to

20   use the glass fiber having the average length and the aspect
ratio in the above-mentioned ranges.

[White pigment (C)]

Examples of the white pigment (C) used in the invention
include titanium oxide, zinc oxide, zinc sulfide, white lead,

zinc sulfate, barium sulfate, calcium carbonate, alumina oxide and the like.

These white pigments may be used alone or in combination of two or more kinds. Moreover, these white
5   pigments can also be used after treating them with a silane coupling agent, a titanium coupling agent or the like. For example, the white pigments may be surface-treated with a silane compound such as vinyltriethoxysilane, 2-aminopropyltriethoxysilane and 2-
10 glycidoxypropyltriethoxysilane. As the white pigments, titanium oxide is particularly preferable, and by using titanium oxide, the optical properties such as reflectance and concealability improve. Further, a rutile-type titanium oxide is preferably used as titanium oxide. Furthermore, a
15 particle size of titanium oxide is 0.05 to 2.0 μm, preferably 0.05 to 0.7 μm.

[Ultraviolet absorber (D)]

The polyamide resin composition of this invention can prevent the discoloration and realize the reduced drop of
20 reflectance in a reflector plate obtained by molding the polyamide resin composition by adding a specific ultraviolet absorber (D), or both an ultraviolet absorber (D) and a hindered amine compound (E).

The ultraviolet absorber (D) of the invention preferably has a heating mass reduction ratio of 0 to 50% by mass, preferably 0 to 40% by mass, and more preferably 0 to 30% by mass when held at 340°C for 10 minutes after

5 elevating the temperature at 20°C/min from 25°C to 340°C under a nitrogen atmosphere.

Further, the ultraviolet absorber (D) particularly preferably comprises one or more compounds selected from a benzotriazole compound, a triazine compound or a

10 benzophenone compound.

Specific examples of the ultraviolet absorber include 2-[2'-hydroxy-3'-(3",4",5",6"-tetrahydrophthalimidemethl)-5'-methylphenyl]-benzotriazole, 2-(4,6-diphenyl-1,3,5-triazin-2-yl)-5-[(hexyl)oxy]-phenol, 2-[4,6-bis(2,4-

15 dimethylphenyl)-1,3,5-triazin-2-yl]-5-(octyloxy)phenol and the like.

[Hindered amine compound (E)]

In the invention, a higher light stability can be obtained by using a combination of the above-mentioned

20 ultraviolet absorber (D) and a hindered amine compound (E).

The hindered amine compound (E) of the invention preferably has a heating mass reduction ratio of 0 to 50% by mass, preferably 0 to 40% by mass, and more preferably 0 to 30% by mass when held at 340°C for 10 minutes after

elevating the temperature at 20°C/min from 25°C to 340°C

under a nitrogen atmosphere.

Specific examples of the hindered amine compound (E)

include N,N',N",N'''-tetrakis-(4,6-bis-(butyl-(N-methyl-

5   2,2,6,6-tetramethylpiperidin-4-yl)amino)-triazin-2-yl)-4,7-

diazadecane-1,10-diamine, poly[{6-((1,1,3,3-

tetramethylbutyl)amino)-1,3,5-triazine-2,4-diyl}{(2,2,6,6-

tetramethyl-4-piperidyl)imino}hexamethylene{(2,2,6,6-

tetramethyl-4-piperidyl)imino}] and the like.

10   [Additives]

The polyamide resin composition of the invention may be

incorporated with the following additives, specifically,

various known compounding agents such as an antioxidant

(phenols, amines, sulfur, phosphorous, etc.), a heat

15   stabilizer (lactone compound, vitamin E group, hydroquinones,

copper halide, iodine compound, etc.), a light stabilizer

(benzotriazoles, triazines, benzophenones, benzoates,

hindered amines, oxanilides, etc.), other polymers (olefins,

modified polyolefines, an olefin copolymer such as an

20   ethylene/propylene copolymer and an ethylene/1-butene

copolymer, an olefin copolymer such as a propylene/1-butene

copolymer, polystyrene, polyamide, polycarbonate, polyacetal,

polysulfone, polyphenylene oxide, a fluororesin, a silicone

resin, LCP, etc.), a flame retardant (bromine-based,

chlorine-based, phosphorus-based, antimony-based, inorganic-based, etc.), a fluorescent brightener, a plasticizer, a thickener, an antistatic agent, a release agent, a pigment and a nucleating agent, in accordance with its application
5   within limits not harmful to the effects of the present invention.

[Polyamide resin composition of the invention]

The polyamide resin composition of the invention can be produced by a known method, for example, by mixing the
10   above-described components using a Henschel mixer, a V blender, a ribbon blender, a tumbler blender or the like, or granulating or crushing the mixed components after they are melt-kneaded using a single-screw or multi-screw extruder, a kneader, a Banbury mixer or the like.
15   Further, the polyamide resin composition of the invention preferably contains the polyamide resin (A) in an amount of 30 to 80% by mass, preferably 40 to 70% by mass, more preferably 45 to 65% by mass, based on 100% by mass of the total amount of the polyamide resin (A), the inorganic
20   filler (B) and the white pigment (C).

The inorganic filler (B) is preferably added to the polyamide resin composition in a proportion of 10 to 60% by mass, preferably 15 to 50% by mass, more preferably 20 to 40% by mass, based on 100% by mass of the total amount of

the polyamide resin (A), the inorganic filler (B) and the white pigment (C).

The white pigment (C) is preferably added to the polyamide resin composition in a proportion of 5 to 50% by mass, preferably 5 to 40% by mass, more preferably 5 to 35% by mass, based on 100% by mass of the total amount of the polyamide resin (A), the inorganic filler (B) and the white pigment (C).

The ultraviolet absorber (D) is preferably added to the polyamide resin composition in a proportion of 0.05 to 3 parts by mass, preferably 0.05 to 2 parts by mass, based on 100 parts by mass of the polyamide resin (A).

The hindered amine compound (E) is preferably added to the polyamide resin composition in a proportion of 0.05 to 3 parts by mass, preferably 0.05 to 2 parts by mass, based on 100 parts by mass of the polyamide resin (A).

The polyamide resin composition of the invention obtained by the above-mentioned method can be suitably used as a reflector plate in that it is excellent in light reflectance, heat resistance, and adhesive properties to a sealing resin such as an epoxy resin and it further realizes a reduced drop of reflectance when used as the reflector plate indoors and outdoors. Further, a molded product that is injection molded from the polyamide resin composition,

with a length of 64 mm, a width of 6 mm and a thickness of

0.8 mm, has a flexural modulus of elasticity of 4500 MPa to

12000 MPa, preferably 4500 MPa to 10000 MPa, as obtained by

measuring in an atmosphere at 130°C under the conditions of

5   a span of 26 mm and a bending speed of 5 mm/min after being

placed in an air oven at 130°C for 20 minutes, and

sufficient rigidity is obtained at the time of insert

molding thereof, and therefore there does not occur a

problem such as peeling in use in insert molded products.

10   [Reflector plate and reflector plate for light emitting

diode device]

The term "reflector plate" as used herein includes a

Chinese character called a "plate", but the concept of this

term is not limited to only one having a "plate" shape.

15 This term includes normal casings or housings in which at

least the direction side to which light is emitted is opened

or not opened. More specifically, the term "reflector

plate" further includes those having general three-

dimensional shapes, provided with a plate (surfaces such as

20 a flat surface, a spherical surface and a curved surface) as

the surface to which light is reflected, such as a box or

case, a funnel, a bowl, a parabola, a cylinder, a cone and a

honeycomb.

In the invention, a reflector plate for an LED device

is shaped into a desired shape by hot forming such as
injection molding (metal insert molding such as hoop
molding), melt molding, extrusion molding, inflation molding,
and blow molding of a resin composition usually comprising a

5   polyamide resin or both a polyamide resin and an inorganic
filler.   The LED reflector plate of the invention is usually
sealed, bonded and adhered to an LED device and other
components with a sealing resin.

Further, the polyamide resin composition and the

10   reflector plate of the invention can be adapted not only for
an LED application, but also for other applications
reflecting light beams. Specifically, it is possible to use
as a reflector plate for a light emitting device such as
various electric/electronic products, indoor lighting,

15   ceiling area lighting, outdoor lighting, automobile lighting,
a display apparatus, and a headlight.

The reflector plate can be prepared by heat melting the
polyamide resin composition for a reflector plate of the
invention to shape into a desired shape and then cooling the

20   resultant. This shaping can be obtained by a method of melt
molding the polyamide resin composition in a mold capable of
forming a desired shape. Specifically, the polyamide resin
composition can be molded into a reflector plate using a
known method such as injection molding, compression molding

and extrusion molding.

Moreover, the reflecting plate or the reflecting plate for a light emitting diode device formed from the polyamide resin composition of the invention preferably has

5 reflectance retention of 80 to 100%, preferably 80 to 90%, more preferably 82 to 85%, as calculated by measuring light reflectance at a wavelength of 470 nm before and after light is irradiated with a metal halide lamp at 40 mW/cm^2 for 48 hours.

10 [Examples]

Hereafter, the present invention is specifically explained on the basis of Examples, but the invention is not limited to these Examples. In Examples and Comparative Examples, the measurement and evaluation of the respective

15 properties were carried out according to the methods described below.

[Intrinsic viscosity [η]]

0.5 g of a polyamide resin was dissolved in 50 ml of a 96.5% sulfuric acid solution, and the number of seconds

20 required for a sample solution to drop under the conditions of 25°C ± 0.05°C was measured using an Ubellohde viscometer and was calculated based on the following formulas:

$[\eta] = \eta SP/[C(1+0.205\eta SP), \eta SP = (t-t0)/t0$

$[\eta]$: intrinsic viscosity (dl/g), ηSP: specific viscosity, C: concentration of sample (g/dl), t: number of seconds required for sample solution to drop (seconds), and t0: number of seconds required for sulfuric acid as a blank

5 to drop (seconds)

[Melting point]

A DSC-7 available from PerkinElmer, Inc. was used. A sample was once held at 330°C for 5 minutes and followed by cooling to 23°C at a rate of 10°C/min. Then, the

10 temperature of the sample was elevated at 10°C/min and an endothermic peak based on melting at this time was defined as a melting point.

[Flexural modulus of elasticity]

An injection molded specimen having a length of 64 mm,

15 a width of 6 mm and a thickness of 0.8 mm was subjected to a bending test in an atmosphere at 130°C under the conditions of a span of 26 mm and a bending speed of 5 mm/min, to measure the flexural modulus of elasticity.

Molding machine: TUPARL TR40S3A manufactured by Sodick

20 Plustech Co., Ltd.

Temperature of cylinder: 335°C

Temperature of mold: 120°C

Bending tester: INTESCO-Model 205 manufactured by INTESCO CO., LTD.

[Reflectance]

Reflectances at wavelengths of 470 nm, 520 nm and 650

nm were measured using an injection molded specimen having a

thickness of 2 mm. The results of the evaluation were

5   indicated by the symbols O: reflectance of 85% or more and

x: reflectance of less than 85%.

Molding machine: IS-55EPN manufactured by TOSHIBA

MACHINE CO., LTD. (Temperature of cylinder: 335°C,

Temperature of mold: 120°C)

10   Measuring apparatus of reflectance: CM3500d

manufactured by Minolta Co., Ltd.

[Evaluation of peeling properties]

A cup-shaped molded product having a length of 3 mm, a

width of 2.5 mm and a height of 2 mm was obtained by hoop

15   molding and an aqueous ink was dropped onto the contact

portion of a hoop material and the cup-shaped molded product

to examine whether or not the aqueous ink permeates into the

contact surface of the cup-shaped molded product and the

hoop material by the capillary phenomenon. The results of

20   the evaluation were indicated by the symbols O: no

permeation and x: permeation.

[Heating mass reduction ratio]

The heating mass reduction ratio of the ultraviolet

absorber (D) and the hindered amine compound (E) were

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measured by thermogravimetric analysis (TG) to examine a TG curve when held at 340°C for 10 minutes after elevating the temperature at a rate of 20°C/min from 25°C to 340°C under a nitrogen atmosphere, and to calculate a mass reduction ratio

5   before and after heating with regard to the ultraviolet absorber (D) and the hindered amine compound (E), based on the following formula:

Heating mass reduction ratio (%) = (W1-W2)/W1 × 100

W1: Mass before heating

10   W2: Mass after heating

[Reflectance retention]

A specimen having a thickness of 2 mm was fabricated by an injection molding machine and the ratio of reflectance after light irradiation to reflectance before light

15   irradiation was calculated by measuring light reflectance at a wavelength of 470 nm before and after light irradiation of the specimen with a metal halide lamp at 40 mW/cm^2 for 48 hours, based on the following formula:

Reflectance retention (%) = (R1-R2)/R1 × 100

20   R1: Light reflectance at wavelength of 470 nm before light irradiation with metal halide lamp

R2: Light reflectance at wavelength of 470 nm after light irradiation with metal halide lamp

Molding machine: IS-55EPN manufactured by TOSHIBA

MACHINE CO., LTD. (Temperature of cylinder: 335°C,

Temperature of mold: 120°C)

Light irradiation apparatus: Eye super UV tester

manufactured by DAINIPPON PLASTICS CO., LTD. (40 mW/cm^2, 48

5 h)

Measuring apparatus of reflectance: CM3500d

manufactured by Minolta Co., Ltd.

[Examples 1 and 2 and Comparative Example 1]

The polyamide resin (A1), the inorganic filler (B) and

10 the white pigment (C) were mixed together at ratios shown in

Table 1 using a tumbler blender, and were fed into a twin-

screw extruder equipped with a vent (BT-40 manufactured by

PLASTIC ENGINEERING RESEARCH CO., LTD.) and melt-kneaded

therein at a setpoint temperature of 320°C to prepare

15 pellet-shaped resin compositions. Then, the respective

properties of the obtained resin compositions were evaluated

and the results thereof are shown in Table 1.

Polyamide resin (A)

Composition: dicarboxylic acid component unit

20 (terephthalic acid/62.5 mol% and adipic acid/37.5 mol%) and

diamine component unit (1,6-diaminohexane/100 mol%)

Intrinsic viscosity [η]: 0.8 dl/g

Melting point: 320°C

Inorganic filler (B): glass fiber (length of 3 mm and aspect ratio of 300)

White pigment (C): titanium oxide (powder, average particle size of 0.21 μm)

5   [Comparative Examples 2 and 3]

Pellet-shaped resin compositions were prepared in the same manner as in Example 1, except that the polyamide resin (A1) was changed to the polyamide resin (A2). Then, the respective properties of the obtained resin compositions

10   were evaluated and the results thereof are shown in Table 1.

Polyamide resin (A2)

Composition: dicarboxylic acid component unit (terephthalic acid/62.5 mol% and adipic acid/37.5 mol%) and diamine component (1,6-diaminohexane/100 mol%)

15   Intrinsic viscosity [η]: 1.0 dl/g

Melting point: 320°C

[Examples 3 to 6 and Comparative Examples 4 and 5]

Pellet-shaped resin compositions were prepared in the same manner as in Example 2, except that ultraviolet

20   absorbers (D1) and (D2) and hindered amine compounds (D3) and (D4) were added at ratios shown in Table 1, based on 100 parts by mass of the polyamide resin (A1).

Then, the respective properties of the obtained resin

compositions for a reflector plate were evaluated and the

results thereof are shown in Table 1.

Ultraviolet absorber (D1): 2-(4,6-diphenyl-1,3,5-

5 triazin-2-yl)-5-[(hexyl)oxy]-phenol

Trade name: TINUVIN 1577FF manufactured by Ciba

Speciality Chemicals, Inc. (heating mass reduction ratio of

20%)

Ultraviolet absorber (D2): ethanediamide, N-(2-

10 ethoxyphenyl)-N'-(2-ethylphenyl)-ethanediamine

Trade name: TINUVIN 312 manufactured by Ciba Speciality

Chemicals, Inc. (heating mass reduction ratio of 100%)

Hindered amine compound (D3): a mixture of

N,N',N'',N'''-tetrakis-(4,6-bis-(butyl-(N-methyl-2,2,6,6-

15 tetramethylpiperidin-4-yl)amino)-triazin-2-yl)-4,7-

diazadecane-1,10-diamine (A) and polymer (B) of dimethyl

succinate and 4-hydroxy-2,2,6,6-tetramethyl-1-piperidine

ethanol

Trade name: CHIMASSORB119FL manufactured by Ciba

20 Speciality Chemicals, Inc. (heating mass reduction ratio of

10%)

Hindered amine compound (D4): poly[{6-((1,1,3,3-

tetramethylbutyl)amino)-1,3,5-triazine-2,4-diyl}{(2,2,6,6-

tetramethyl-4-piperidyl)imino}hexamethylene{(2,2,6,6-

tetramethyl-4-piperidyl)imino}]

Trade name: CHIMASSORB944FDL manufactured by Ciba

Speciality Chemicals, Inc. (heating mass reduction ratio of

5   4%)

[Table 1]

	Unit	Ex. 1	Ex. 2	Ex. 3	Ex. 4	Ex. 5	Ex. 6	Comp. Ex. 1	Comp. Ex. 2	Comp. Ex. 3	Comp. Ex. 4	Comp. Ex. 5
Polyamide resin (A1)	% by mass	60	60	60	60	60	60	67	0	0	60	60
Polyamide resin (A2)	% by mass	0	0	0	0	0	0	0	67	60	0	0
Intrinsic viscosity [η]	dl/g	0.8	0.8	0.8	0.8	0.8	0.8	0.8	1	1	0.8	0.8
Inorganic filler (B)	% by mass	30	25	25	25	25	25	22	22	30	25	25
White pigment (C)	part(s) by mass	11	15	15	15	15	15	11	11	11	15	15
Ultraviolet absorber (D1)	part(s) by mass	0	0	0.3	0.4	0.3	0.4	0	0	0	0	0
Ultraviolet absorber (D2)	part(s) by mass	0	0	0	0	0	0	0	0	0	0.3	0
Hindered amine compound (D3)	part(s) by mass	0	0	0.6	0.8	0	0	0	0	0	0.6	0.8
Hindered amine compound (D4)	part(s) by mass	0	0	0	0	0.6	0	0	0	0	0	0
flexural modulus of elasticity	MPa	6000	5000	5000	5000	5000	5000	4000	4000	6000	5000	5000
Peeling properties	-	O	O	O	O	O	O	×	×	Poor filling	O	O
Reflectance 470 nm	-	O	O	O	O	O	O	O	O	O	O	O
Reflectance 520 nm	-	O	O	O	O	O	O	O	O	O	O	O
Reflectance 650 nm	-	O	O	O	O	O	O	O	O	O	O	O

SF-1278

[Table 1. Continued]

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Reflectance retention	%	Not determined	78	82	83	84	80	Not deter mined	Not deter mined	Not determ ined	78	78

INDUSTRIAL APPLICABILITY

   The polyamide resin composition according to the present

invention having excellent mechanical strength and excellent

5   heat resistance, high light reflectance, high light

shielding properties and high light resistance can be

suitably used as a reflector plate for an LED device or a

reflector plate for a light emitting device such as various

electric/electronic products, indoor lighting, ceiling area

10   lighting, outdoor lighting, automobile lighting, a display

apparatus, and a headlight.